

MODEL 2-60 NEURAC SPECIAL-PURPOSE DIGITAL COMPUTER

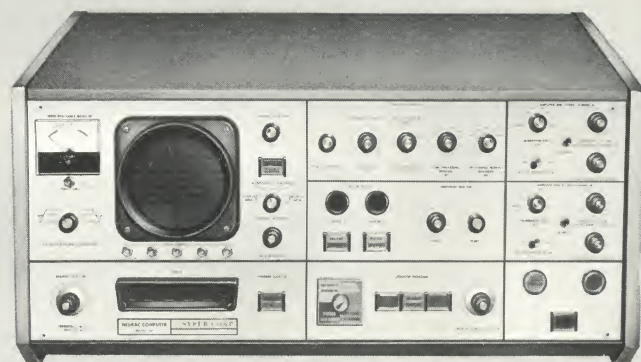


Effective October 1964

FS-17

Model 2-60 Neurac

- NO INTEGRATION OR INTERFACE PROBLEMS
- ACCEPTS LOW LEVEL SIGNALS DIRECTLY
- CUSTOM DESIGNED HIGH PERFORMANCE AMPLIFIERS WITH SHARP CUT-OFF BANDPASS FILTERS
- INTEGRAL 5 INCH OSCILLOSCOPE
- OBJECTIVE VISUAL FIELD PATTERNS DISPLAYED IN STANDARD FORMAT
- MONITORS EEG AND ERG SIGNALS SIMULTANEOUSLY
- SELF PROGRAMMING CAPABILITY
- INTEGRAL SIMULATOR FOR SIGNAL-TO-NOISE CAPABILITY
- SELF CHECKING
- COMPATIBLE VISUAL, AUDIO, AND TACTILE STIMULATOR GENERATOR AVAILABLE



MODEL 2-60 NEURAC COMPUTER RAPIDLY MEASURES RESPONSES TO SENSORY STIMULI ON A TRULY OBJECTIVE LEVEL

The Neurac 2-60 is a multi-purpose digital computer designed to record small evoked occipital potentials produced in response to local retinal stimulation. This permits clinical research applications of powerful signal-to-noise extractions available previously in only fully equipped research laboratories. Now the analysis of neuroelectric data can be performed on-line by the use of a single instrument whose operation involves the highest degree of facility as well as accuracy.

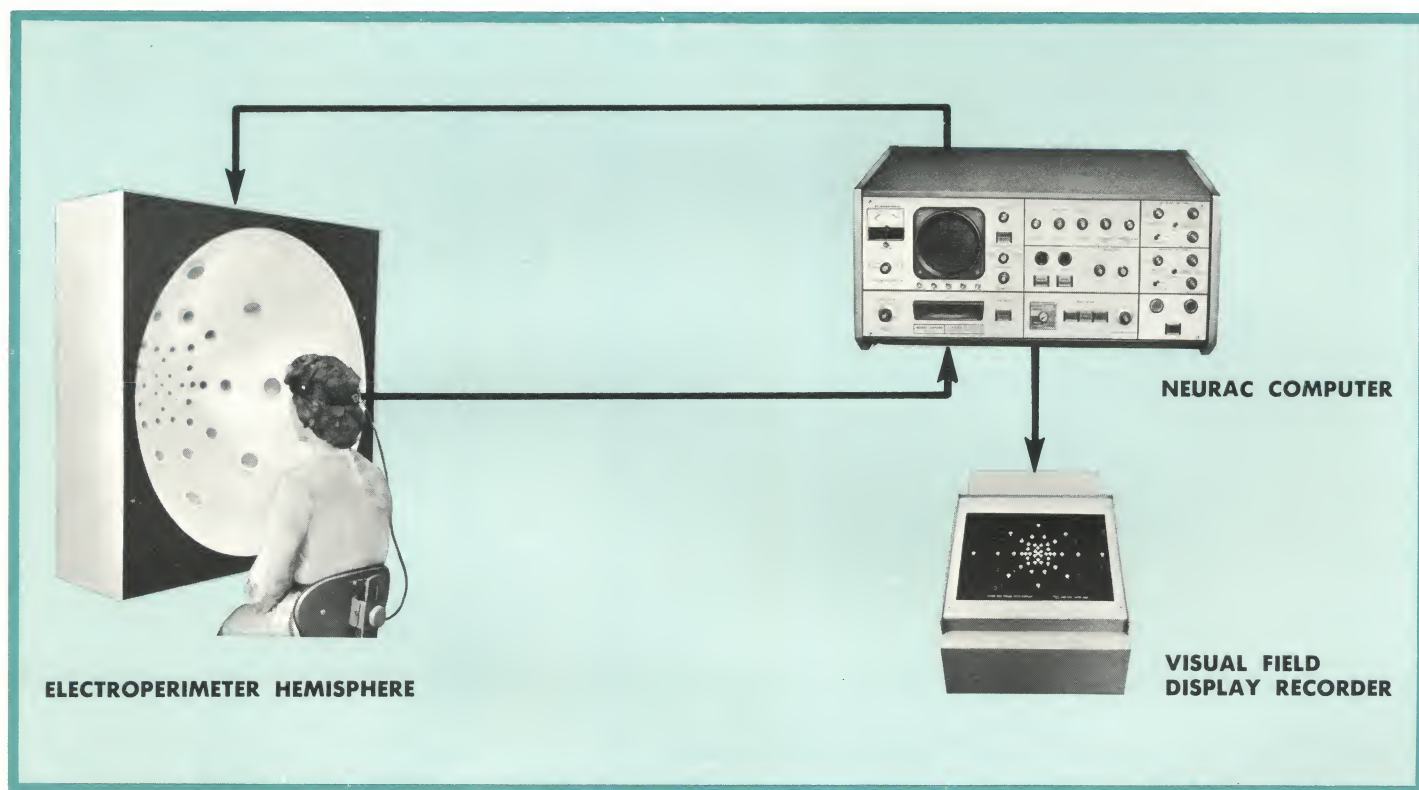
The Neurac 2-60 consists of a wholly integrated unit which includes the necessary components for research studies in various areas of visual function investigations. They potentially include visual acuity testing, dark adaptation, visual field testing, color blindness, night blindness, and spectral sensitivity of the eye.

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The computer is capable of administering an externally applied stimulus; processing the ensuing neuroelectric data; and automatically recognizing the presence of evoked responses. The evoked responses are isolated and become available for analysis even when masked by dense background noise. The signals are displayed on an integral CRT and outputs can be fed to X-Y plotters or tape devices for subsequent studies. The Neurac 2-60, with two discrete channels, provides the capability of simultaneously processing both EEG and ERG signals.

Today's clinical research investigator now has the capability of experimental study of visual field testing on an objective level, using instrumentation designed for his particular interest. Since Neurac computer implementation is completely objective, it can be potentially used on infants, elderly persons, non-communicative subjects, critically ill patients, psychiatrically disturbed patients, comatose or anesthetized subjects. In addition, the Neurac system can be used whether the

subject is prone, standing, or sitting. The Neurac 2-60 electroperimeter system offers a unique technique to the investigator for rapidly measuring evoked responses from stimuli at different locations in a truly objective test. In this application the subject is completely removed from the information loop — there is no need for specific subject response. The complete system includes the Neurac 2-60, a custom designed Electroperimeter Hemisphere, and a Visual Field Display Recorder. The Electroperimeter Hemisphere is a visual stimulus generator consisting of 45 Xenon lamps encompassing a normal visual field. The Visual Field Display Recorder is a memory device which indicates the results and the retinal point under immediate test. The display is available to the investigator for analysis until the Neurac computer has been cleared and the experiment has been concluded.



ELECTROPERIMETRY APPLICATION

The Neurac 2-60 automatically programs the Electroperimeter's 45 Xenon gas discharge lamps to flash sequentially in a preset order within the uniform background illuminated hemispheric target. Manual selection of each of the lamps is controlled at the console of the Neurac 2-60. An interrupt pushbutton at the console permits any specific test point to be aborted and to be restarted without losing data from previous test points. The test may then be resumed at the discretion of the operator.

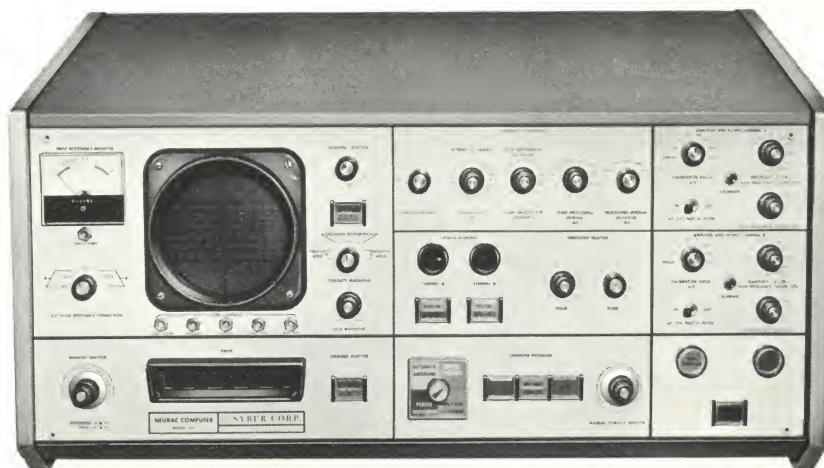
In the electroperimetry application, a small collimated flickering beam of light impinges on a selected portion of the retina of the subject's eye from a predesignated spatial point.

The light source activates nerve cells in the retina which discharge and send impulses through the visual pathways of the subject and terminate in the visual cortex. The small evoked visual response at the cortex is usually masked by the normal unrelated electrical activity of the brain. Two differential electrodes at the occiput convey this neuroelectric activity to the Neurac computer. The Neurac isolates the evoked response from the unrelated activity by an averaging method and determines whether retinal activity has been recorded at the occiput. The conduction or non-conduction of the evoked retinal signal through the visual pathways is determined on a "yes" or "no" basis by

means of empirically derived data preset into the Neurac. This empirically derived data is determined by the area under a response curve, and is a function of restimulation and the psychological state of the patient. The computer instructs the Visual Field Display Recorder to record a conduction or non-conduction for each of the respective visual pathways of the retinal points tested. An oscilloscope on the Neurac console allows evoked responses or incoming analog signals to be displayed. Since a programmed visual conduction/non-conduction threshold is established for each test point, the oscilloscope may alternatively be used to compare the actual measured evoked response for each test point to the programmed evoked response threshold. By this means, a confidence factor on the validity of evoked responses may be established. A second channel is available to simultaneously record another evoked potential such as an ERG to further aid in diagnosis.

The Neurac 2-60 in the electroperimetry configuration can also be used for automatically administering and recording objective hearing and tactile sensory studies.

NEURAC COMPUTER



SPECIFICATIONS

INPUT:

Two fully independent channels for averaging and amplitude histograms. Simultaneous and complete display of both channels. Period histogram, one channel at a time.

INPUT AMPLIFIERS (including external preamplifiers):

Minimum usable input level — 3.0 microvolts

Input — Three wire differential, or amplifier by-pass

Voltage amplification — Adjustable from 1000 to one million using both external preamp and amplifiers
— Adjustable from one to one thousand using amplifiers only

Input impedance — three megohms or better, either single ended or differential

Common mode rejection — 80 db

Frequency response — 0.1 cps to 3 kc (— 6 db half amplitude)

Noise — 3.0 microvolts rms with 10k source impedance

Output voltage — ± 3 volts, centered about 2.5 volts

Calibrate signals — 50 microvolts

BANDPASS FILTERS (five pole):

High frequency cutoff and adjustable; 6, 45, 220, 700, 3000 cps

Low frequency cutoff adjustable; 0.1, 1, 6, 12, 75 cps

(60 cps Notch filter, switched in or out)

ANALYSIS POINTS OR ADDRESSES:

60 per channel — algebraically stored

ANALYSIS TIME:

62.5, 125, 250, 500, 1000 milliseconds

MEMORY CAPACITY:

2^{12} + sign bit + parity bit

ANALYSIS DELAY TIME:

Zero to 937.5 milliseconds in steps of 62.5 milliseconds

VARIABLE DELAY DATA PROCESSING:

60 addresses may be spread over full scale, expanded or contracted over any portion of the displayed evoked response. Area integration may be restricted to specific segments of the evoked response.

NUMBER OF SAMPLES:

1, 2, 4, 8, 16, 32, 64, 125, 256, or external control

STIMULUS RATE:

1, 2, 4, 8, 16 pps or external control (15 pps maximum)

DYNAMIC ACCURACY:

0.77% from DC to 200 cps

ANALOG-TO-DIGITAL CONVERSION TIME:

Fixed at 25 microseconds for a 7 bit conversion (one part in 128) address value not dependent on sampling rate.

PROCESSING WINDOW FOR EVOKED RESPONSE (intensified on CRT display):

Start address — 0, 6, 12, 18, 24, 30, 36, 42, 48, 54

Stop address — 5, 11, 17, 23, 29, 35, 41, 47, 53, 59

EVOKED RESPONSE CRITERIA:

Independent calculation of total and either positive or negative portions of the evoked response.

EVOKED RESPONSE CRITERION SELECTOR:

Two channel evoked response decision making capability

Wide range of values may be programmed into computer by switches for comparison to evoked responses

Value of evoked response and criterion value are simultaneously displayed on CRT for quick look at graded evoked responses to within 3% in order to determine how close evoked response is to predetermined threshold.

Note: Evoked responses may be graded to within 0.77% accuracy by decimal readout.

SIGNAL-TO-NOISE CALIBRATION:

Built-in signal-to-noise generators, each with independent control. Can be used independently or mixed to simulate coherent signals masked by background noise and presented to computer input for test and calibration.

OSCILLOSCOPE DISPLAY:

Five inch high quality cathode ray tube with bezel for oscilloscope camera.

BASELINE:

Fixed — no partitioning or wrap around of evoked response display.

DIGITAL DISPLAY:

Bipolar four decimal digit readout. Value of each of the 60 addresses of either channel or area or any part of evoked response may be displayed by selector switch. Digital display preserves 0.77% input accuracy.

INPUT WAVEFORM MONITOR:

Either channel or both may be simultaneously displayed by means of switch to monitor input analog data from amplifiers (EEG, ERG, etc.).

ANALOG OUTPUT TERMINALS:

Analog signals may be readily connected to a variety of auxiliary devices such as EEG recorders.

POWER REQUIREMENTS:

120 vac, 50 to 400 cps, 350 volt-amperes

PHYSICAL DIMENSIONS:

31 in. W x 15 in. H x 21 in. D

WEIGHT:

80 pounds

CONSTRUCTION:

Completely transistorized



MODEL 2-60 NEURAC SPECIAL-PURPOSE DIGITAL COMPUTER

ELECTROPERIMETER HEMISPHERE



SPECIFICATIONS

PERIMETER SIZE:

½ meter radius

LAMP DESCRIPTION:

45 Xenon gas discharge lamps
Preset flashing sequence set at Neurac 2-60 console
Six discrete lamp intensities adjustable at Electroperimeter
Ten microsecond nominal flash duration
Color filters and diffusers available

POWER REQUIREMENTS:

105-125 vac, 400 cps, 100 volt-amperes

PHYSICAL DIMENSIONS:

6 ft. H x 5 ft. W x 3 ft. D (approximately)

WEIGHT:

120 pounds (approximately)

VISUAL FIELD DISPLAY RECORDER



SPECIFICATIONS

DISPLAY SIZE:

9 inches x 12 inches

NUMBER OF POINTS:

45 to match Electroperimeter lamps

TYPE:

Electroluminescent dots

COLORS:

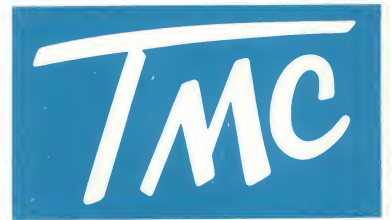
Seeing area — green dot
Non-seeing area — neutral dot
Current point under test — red dot
Untested points — blue dot
Permanent record can easily be traced over display

AUXILIARY EQUIPMENT

Audio Stimulus Generators	Input Simulator to calibrate signal to noise ratios
Tactile Stimulus Generators	
Two Channel EEG Recorder	Electrodes with or without head harness
Electrode Junction Box	Single Portable Xenon Strobe Lamp
Mobile Cart	

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MODEL 400C COMPUTER OF AVERAGE TRANSIENTS — CAT —



Model 400C Computer of Average Transients — CAT — • FS-16 • Effective February 1965

- ACCEPTS UP TO FOUR INPUTS OF ANALOG DATA
- ISOLATED INPUTS — ACCEPTS SIGNALS FROM PUSH-PULL SOURCES
- HISTOGRAM AND CORRELATION CAPABILITIES
- DATA TRANSFER FROM ONE MEMORY QUARTER TO ANY OTHER MEMORY QUARTER — FROM ONE MEMORY HALF TO THE OTHER MEMORY HALF
- EXTERNAL ADD/SUBTRACT CONTROL
- READOUT CAPABILITY TO X-Y AND POINT PLOTTERS — TO COMPUTER COMPATIBLE MAGNETIC TAPE



**NEW, IMPROVED MODEL 400C (CAT)[®]
HAS INCREASED MEMORY CAPACITY . . . DATA TRANSFER . . .
OTHER NEW FEATURES . . . FOR ON-LINE ISOLATION OF SPECIFIC
SIGNAL RESPONSES MASKED BY BACKGROUND NOISE**

MORE FLEXIBLE . . . MORE VERSATILE . . . MORE CAPABLE THAN EVER

The unparalleled world-wide acceptance of the Technical Measurement Corporation CAT 400B Computer of Average Transients has led to a demand for a new, more comprehensive model specifically designed to meet new and broader research requirements. Now the new CAT's increased 10^6 -1 memory capacity enables the experimenter to store more data per address than ever before . . . an added data transfer feature permits the transfer of data from one memory half to another memory half or data from one memory quarter to any other memory quarter — this bidirectional data transfer speeds research information processing . . . external Add/Subtract may be controlled by external sources . . . a blanking signal provides sharper display and clearer images for research photography when an external oscilloscope is used . . . the intensification of every 10th address plus full blanking between addresses eases monitoring by assuring clearer, more readable display.

The CAT 400C incorporates its own analog-to-digital converters. Both digital and analog outputs are available for further processing along with the continuous display of the integral CRT — for a full range of readout on compatible TMC equipment.

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MODEL 400C COMPUTER OF AVERAGE TRANSIENTS — CAT —

This new CAT multi-purpose digital computer provides all the averaging functions of its predecessor, the Model 400B, in an improved instrument with most wanted new features. It also offers as *standard* equipment features previously available only at additional expense. Erasing of individual quarters and control of read-out are now incorporated in the Model 400C.

The CAT 400C is the keystone of a completely integrated data reduction system. The CAT provides a summation (averaging) of analog signals masked by random background noise by converting these signals into digital numbers. These numbers are stored in 400 memory addresses starting from a known reference point. The increase in signal-to-noise ratio is achieved by serially adding together repetitive signals. With each successive analysis sweep, the numbers stored in each memory address are added — and those signal components phase-locked to the reference point are isolated from the out-of-phase background noise. The improvement in the signal-to-noise ratio is proportional to the square root of the number of responses summed.

A clearly defined signal is produced which can be monitored on-line, and parameters adjusted, by the investigator while the experiment is in progress — or it can be read out in digital or analog form non-destructively.

The CAT 400C serves as the basic unit in a building block system providing a multitude of additional statistical signal processing applications. When combined with the TMC Correlation Computer, COR.256, a multi-purpose data analysis system is formed for the computing of auto- or crosscorrelation functions, in addition to signal averaging. Series 600 Accessory units have been specifically designed for operation with the CAT 400C: they provide for histogram computations and include, Model 605 Amplitude Discriminator, Model 606 Amplitude-to-Time Converter, Model 607 Peak Detector and Window Discriminator, and Models 645, 646 Preset Sweep Counters. Addition and subtraction of memory contents as well as curve integration can be accomplished with the Model 522 Resolver-Integrator. For complete system data handling, TMC offers printers, computer compatible magnetic tape readout, paper tape punches and readers, X-Y and point plotters, and typewriters for permanently recording CAT readout data.

The use of solid state circuitry results in a compact, lightweight system, completely portable. This has been achieved with no sacrifice of performance or reliability. Clearly defined miniaturized controls have been provided for simplicity of operation.

The CAT 400C is housed in a custom designed cabinet to insure optimum performance under rugged environmental conditions. The components are mounted on plug-in type printed circuit boards of proven reliability and are readily accessible by removing the side panels. Complete operating instructions are provided with each system.

SPECIFICATIONS

INPUT:

Four (4) electrically isolated from ground. Signal to be applied to pins No. 1 and No. 2 of input connector. Pin No. 3 is connected to chassis ground and may be used to connect shield of input cable. Input impedance is 20,000 ohms.

Maximum signal input is ± 3 volts with respect to return conductor for $\pm 50\%$ deviation of modulator frequency.

Floating input accepts dc levels up to ± 150 volts maximum with respect to chassis ground.

ANALYSIS POINTS OR ADDRESSES:

400.

SWEEP TIME:

Analysis times available to sweep through 400 addresses are 31.25, 62.5, 125, 250 milliseconds; 0.5, 1, 2, 4, 8, 16 seconds. Sweep rates may also be externally controlled through a BNC connector at the rear of the CAT Model 400C. Maximum external address advance rate is 20,000 pulses per second (0.020 seconds for 400 addresses).

MEMORY CAPACITY:

Memory capacity available in each of 400 addresses is 10^6-1 .

MEMORY STORAGE CYCLE TIME:

36 microseconds for complete read-write cycle.

SWEEP DELAY:

An adjustable delay is available between trigger pulse and the initiation of an analysis sweep. It is continuously variable between approximately 0.1 second and 10 seconds. In the zero position analysis sweeps start immediately after the trigger pulse.

PRINT/PLOT CAPABILITY:

Switch positions are available for both digital readout equipment (printers, typewriters, punch paper tape, point plotters) and analog equipment (X-Y plotters, X-Y strip chart recorders).

READOUT PROVISIONS:

Digital arithmetic data in 24 line Binary Coded Decimal (BCD). Digital address data in 10 line Binary Coded Decimal (BCD).

Analog voltage of 100 millivolts full scale in both X and Y direction.

READOUT SPEEDS:

The readout speed in the plot mode is continuously variable between 12 and 120 seconds. In the print mode, readout speed is controlled by the digital readout device. Readout speeds correspond to the time required to read out memory contents of all 400 addresses.

DISPLAY CAPABILITY:

Integral 3 inch cathode-ray tube with every 10th address intensified. X-Y and Blanking signal for external oscilloscope.

DATA TRANSFER:

Data may be transferred from one memory quarter to any other memory quarter or from one memory half to the other memory half.

CONVERTER AC/DC LINEARITY:

$\pm 0.5\%$ of full scale maximum deviation from best straight line through zero.

CONVERTER FREQUENCIES:

Cards are supplied with each unit. A 250 KC converter is standard. (5, 50, 100, 500 KC converters optional)

OPERATING TEMPERATURE RANGE:

40°F to 105°F

POWER:

Approximately 30 watts.

OPERATING VOLTAGES:

100, 115, 200, 215, or 230 volts $\pm 10\%$; 50 to 400 cps.

SIZE:

8½ in. W x 10¼ in. H x 21 in. D. (Approximately 1 cubic foot).

WEIGHT:

Approximately 35 pounds.

Patented Under U.S. Patent #3,087,487 and Foreign Patents.

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